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# Proposed Experimental Actions for Water Years 2005-2006 Colorado River, Arizona, in Glen Canyon National Recreation Area and Grand Canyon National Park

U.S. Department of the Interior, Bureau of Reclamation

National Park Service

U.S. Geological Survey

# United States Department of the Interior

BUREAU OF RECLAMATION
Upper Colorado Regional Office
125 South State Street, Room 6107
Salt Lake City, Utah 84138-1102

IN REPLY REFER TO:

UC-700
ENV-9.00

November 5, 2004

Dear Interested Parties:

The enclosed document is a supplement to an environmental assessment that was sent out for public comment in September 2002 by the Bureau of Reclamation, the National Park Service, and U.S. Geological Survey. It is being sent to you by the Bureau of Reclamation on behalf of the other two Federal agencies. The environmental assessment analyzed the effects of proposed experimental releases from Glen Canyon Dam and mechanical removal of non-native fish from the Colorado River in Grand Canyon. These actions were proposed to improve both sediment conservation and conditions for the survival of the endangered humpback chub in Grand Canyon National Park.

The proposed action in this supplement extends the duration of mechanical removal of non-native fish species and non-native fish suppression releases. It moves the timing of a potential experimental high flow forward from January to November, reflecting the recommendation of scientists. It also provides testing of stable fall flows, hypothesized to benefit endangered fish and their habitat and sediment conservation.

If you have any concerns or issues with the proposed modification and wish to provide comments to the Federal action agencies, please contact Dennis Kubly by e-mail at dkubly@uc.usbr.gov or by letter at the following address:

Dennis Kubly, UC-730
Bureau of Reclamation
Upper Colorado Region
125 South State Street, Room 6107
Salt Lake City UT 84138-1102

**Your comments will need to be received no later than noon on November 19, 2004**. Once the public comments have been received and reviewed, the Federal agencies will make a decision on whether to proceed with the proposed modification.

Sincerely,

Randall V. Peterson
Manager, Environmental Resources Division

Enclosure

# DRAFT SUPPLEMENTAL ENVIRONMENTAL ASSESSMENT

PROPOSED EXPERIMENTAL ACTIONS FOR WATER YEARS 2005-2006
COLORADO RIVER, ARIZONA, IN GLEN CANYON NATIONAL RECREATION AREA AND GRAND CANYON NATIONAL PARK

PREPARED BY
U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION, UPPER COLORADO REGION
NATIONAL PARK SERVICE, GRAND CANYON NATIONAL PARK AND GLEN CANYON NATIONAL RECREATION AREA
AND
U.S. GEOLOGICAL SURVEY, GRAND CANYON MONITORING AND RESEARCH CENTER

NOVEMBER 5, 2004

## INTRODUCTION

In September 2002 the Bureau of Reclamation, National Park Service (NPS), and U.S. Geological Survey released an environmental assessment (EA) on proposed experimental releases from Glen Canyon Dam and removal of non-native fish from the Colorado River in Grand Canyon, Arizona (Bureau of Reclamation, NPS, and USGS 2002). The experiment was developed by the Grand Canyon Monitoring and Research Center of the U.S. Geological Survey (GCMRC), cooperating scientists, and the Technical Work Group (TWG) of the Glen Canyon Dam Adaptive Management Program (GCDAMP). It was recommended to the Secretary of the Interior by the Adaptive Management Work Group (AMWG), a Federal Advisory Committee charged with providing input to the Secretary pursuant to fulfilling provisions of the Grand Canyon Protection Act. In December 2002, following tribal consultation, public meetings, and responses to comments by the federal agencies and the public, the Secretary of the Interior concurred with the agencies' finding of no significant impact for the proposed project and agreed that the experiment should move forward.

Pursuant to the Secretary's decision, Reclamation began releases of daily fluctuating flows in January 2003 designed to negatively affect reproduction and recruitment of non-native fish, primarily trout, in the Colorado River below the dam. The objective of this experiment was to reduce the number of non-native fishes that potentially prey on or compete with the federally-endangered humpback chub (HBC, *Gila cypha*) in this reach of the river. The primary control mechanisms are disruption of spawning activities, desiccation of embryos in spawning gravels, and reduced survival of young trout after they emerge from spawning gravels due to displacement from favored habitats in the zone of fluctuation between the daily low (5,000 cubic feet per second [cfs]) and high (20,000 cfs) releases. Non-native suppression releases continued through March 31, 2003, at which time releases returned to those identified in the preferred alternative implemented by the 1996 Record of Decision on the Operation of Glen Canyon Dam.

In January 2003, the Grand Canyon Monitoring and Research Center initiated mechanical removal of non-native fishes from the Colorado River in Grand Canyon in a 9.4-mile reach approximately 5 miles above and 4 miles below the confluence of the Little Colorado River. In July 2003, the three federal action agencies produced a supplemental environmental assessment to extend the reach of mechanical removal another 7 miles downstream to a point 73 miles below Lees Ferry. The action was modified to extend the area of mechanical control following a finding of no significant impact by the action agencies and a biological opinion issued by the U.S. Fish and Wildlife Service on August 12, 2003.

In November 2003, the Western Area Power Administration (Western) identified to members of the TWG that costs of replacement power exceeded projections identified in the 2002 EA. Western proposed a modified flow regime that would reduce the cost of replacement power by approximately $2 million a month and still have the desired effects on non-native fish. Their modified flow regime had two components: (1) increasing the duration of maximum release by two hours, from 9 hours to 11 hours each day, during Monday through Saturday and (2) decreasing the fluctuations from 5,000-20,000 cfs to 5,000-8,000 cfs on Sunday. The primary reason for reducing the Sunday fluctuations was to compensate for additional water released during Monday through Saturday. No change in ramping rates (the rate at which releases increase and decrease) was proposed. A supplemental EA with a finding of no significant impact was completed by the action agencies and the modified releases were implemented from January-March 2004.

## PURPOSE AND NEED FOR ACTION

The three agencies that proposed the 2002 EA (Reclamation, NPS, and USGS 2002) are now proposing to extend the duration of the mechanical removal and non-native fish suppression flows assessed in the 2002 EA and subsequent supplements, and to slightly modify some of the components of the Proposed Action. The original purpose and need as stated in the 2002 EA is unchanged: (1) to contribute to the conservation of endangered native fish, especially the humpback chub, by reducing populations of non-native fish who compete with and prey on native fish in the Colorado River between Glen Canyon Dam and Lake Mead; (2) to conserve fine sediments that form sandbars, beaches, and habitat for young native fish by altering dam operations; and (3) to improve the Lees Ferry sport fishery by reducing the overabundance of trout. These proposals are within the constraints established by statutes (commonly known as the "Law of the River") and other applicable legal obligations.

The need for the Proposed Action arises because the Grand Canyon population of endangered humpback chub has declined during the last decade (GCMRC 2003), and fine sediment has been exported to such an extent that camping beaches and sandbars continue to be washed downstream and lost (Rubin et al. 2002). The Proposed Action would provide important information that will be used as additional operational and physical modifications are considered regarding future operation of Glen Canyon Dam.

This EA is linked or tiered to the 2002 EA. It is also tiered to the Final Environmental Impact Statement for the Operation of Glen Canyon Dam (Reclamation 1995).

## DESCRIPTION OF ALTERNATIVES

There are two alternatives for water years 2005-2006, a No Action and a Proposed Action. Both actions have the potential for several releases from Glen Canyon Dam including: (1) low steady flows of approximately 8,000 cfs; (2) low daily fluctuating flows in the range of 5,000-10,000 cfs; (3) daily fluctuating flows constrained by provisions of the 1996 Record of Decision on the Operation of Glen Canyon Dam; and (3) a high experimental flow of approximately 41,000 cfs if Paria River and upper Marble Canyon tributary sediment input targets are met. The Proposed Action, but not the No Action, also includes mechanical removal of non-native fish from the Colorado River above and below the mouth of the Little Colorado River and non-native fish suppression flows having daily fluctuations of 5,000-20,000 cfs.

The two alternatives with and without sediment triggers being attained are portrayed in Figures 1 and 2. Table 1 provides additional information on anticipated monthly dam releases and daily fluctuations, while Table 2 identifies important differences between the two alternatives.

### NO ACTION

The 2002 EA analyzed the effects of experimental high flows triggered by sediment inputs from the Paria River and ungaged tributaries in upper Marble Canyon (Table 2) for an indefinite period because of the uncertainty of when the trigger would be attained. Attaining the first sediment input trigger on September 1 caused a change from Record of Decision fluctuating flows to sequential low fluctuating and low steady flows. A second trigger on October 31 caused a decision on whether to continue with the sequential fluctuating and steady flows, or to return to Record of Decision flows. The final trigger, on December 31, determined whether the high experimental flow would be released in early January. Mechanical removal of non-native fish and winter non-native fish suppression flows, in contrast, were only analyzed for the period 2003-2004. Therefore, they are not part of the No Action alternative.

### PROPOSED ACTION

In August 2004, the AMWG passed a recommendation to the Secretary of the Interior to continue in water year 2005 all components of the experimental action that had been in place during 2003-2004. Some aspects of the recommendation subsequently were clarified in a conference call with the Assistant Secretary of the Interior for Water and Science. Department of the Interior agency AMWG representatives were then queried for their responses to a Proposed Action that largely followed the AMWG recommendation, but implemented the action for both water years 2005 and 2006.

The Proposed Action in water years 2005 and 2006 contains all aspects of the Proposed Action that was implemented in water years 2003-2004, including sediment triggers for a high experimental flow, non-native suppression flows, and mechanical removal of non-native fish in the Colorado River above and below the mouth of the Little Colorado River. Modifications in the Proposed Action for water years 2005-2006 include: (1) the high experimental flow likely would be closer to 41,000 cfs than 42,000-45,000 cfs because of the drought-induced reduction in the level of Lake Powell and because of maintenance occurring at Glen Canyon Dam; (2) the timing of the high experimental flow would be moved forward from January to November-December, specifically no earlier than November 15; (3) non-native fish suppression flows with fluctuations of 5,000-20,000 cfs Monday through Saturday and Sunday fluctuations of 5,000-8,000 cfs would be extended from the end of March to April 7; (4) regardless of achieving the relevant sediment triggers, September and October releases in both calendar years 2005 and 2006 will be sequential periods of steady (8,000 cfs) and low fluctuating (approximately 6,500-9,000 cfs) flows, with duration and magnitude determined by research requirements; and (5) mechanical removal of non-native fish in the Colorado River would occur between River Miles 56.2 and 68.5, a slight reduction from previous efforts.

Anticipated dam releases and periods of non-native mechanical removal for the No Action and Proposed Action scenarios are shown in Figures 1 and 2. Both the No Action and Proposed Action contain scenarios without and with sediment triggers being attained that would lead to the release of a high experimental flow from Glen Canyon Dam. Non-native fish suppression flows during the period January 1 through the first week of April and mechanical removal of non-native fish near the mouth of the Little Colorado River would not occur under the No Action. A detailed hydrograph of the high experimental flow is provided in Figure 3.

## AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES

The affected environment for the No Action and Proposed Action alternatives is the same as identified in the September 2002 EA and is hereby incorporated by reference.

Annual dam releases as determined by the Secretary's long-range operating criteria will be the same under both the No Action and Proposed Action alternatives; however, monthly release volumes would differ depending on if and when the high experimental flow occurs, November-December or January (Table 1). These differences also would be manifested in minor changes during the year in the elevation of Lake Powell.

**Environmental Consequences**

Resources considered in the analysis of effects are the same as those considered in the 2002 EA. They include sediment, the aquatic and terrestrial food base, reptiles and amphibians, trout and other non-native fish, federally-listed species (Kanab ambersnail, humpback chub, razorback sucker, southwestern willow flycatcher, bald eagle, and California condor), recreational activities, cultural resources, and hydropower. The effects of alternating low steady and low fluctuating flows, high experimental flows, and non-native fish suppression flows are described for each of these environmental variables.

**Sediment**

Alternating Low Steady and Low Fluctuating Flows

Record of Decision daily fluctuating flows, alternating low steady and low fluctuating flows, and the high experimental flow can occur under No Action and the Proposed Action (Figures 1 and 2, Tables 1 and 2). Alternating low steady and low fluctuating flows occur only with a sediment input of 500,000 metric tons after September 1 under No Action, but with or without this sediment input under the Proposed Action. Continuous Record of Decision fluctuating flows under No Action are predicted to export more fine sediment during September and October than the alternating low steady and low fluctuating flows.

High Experimental Flow

Implementation of the high experimental flow in November-December under the Proposed Action, as opposed to January under the No Action, would benefit fine sediment retention because the amount of fine sediment retained would increase with proximity to the events that delivered the sediment to the Colorado River. The Proposed Action also more closely follows the first recommendation of Rubin et al. (2002) to conduct a high experimental flow as soon as possible following tributary sediment inputs in the July-October sediment input season. Fine sediment export from Marble Canyon associated with normal December operations under Record of Decision fluctuations following the high experimental flow will be mitigated to some degree, as a percentage of the recent sediment input(s) will be stored along shorelines above the high stage of the December fluctuating flows.

Non-native Fish Suppression Flows

Sand transport rating curves developed from data collected at the Grand Canyon gage in water year 2003 have been evaluated to assess the influence of fluctuating flows in the range of 5,000-20,000 cfs. For a monthly release volume of 500,000 acre-feet following a

high experimental flow, there would be an increase of between 140% and 234% in suspended sand export over releases that would otherwise occur under the No Action (D. Topping, personal communication). For a 600,000 acre-foot month, this increase is predicted to be between 216% and 390% above export under the No Action.

The volume of fine sediment export from Marble Canyon that occurs under the Proposed Action will depend on the prior history of Paria River fine sediment production. Fine sediment export volumes measured at the Grand Canyon gage will depend on fine sediment production from both the Paria and Little Colorado Rivers. If non-native fish suppression flows are preceded by a high experimental flow in November, the net volume of fine sediment exported during the January-early April fluctuations should be reduced owing to the potential for newly input fine sediment to be stored along shorelines above the 20,000 cfs stage.

Erosion of sand bars likely will be increased when non-native fish suppression flows occur in the absence of a high experimental flow. Fine sediments will not have been elevated above the reach of the non-native fish suppression flows and the daily stage will reach higher onto sand bars than would Record of Decision fluctuating flows.

**Aquatic and Terrestrial Food Base**

Alternating Low Steady and Low Fluctuating Flows

These releases can occur under both the No Action and Proposed Action alternatives, but only with a sediment trigger in the former. Two-week periods of these flows are not likely long enough to produce measurable differences in the biomass or growth of aquatic or terrestrial food base species. There likely will be measurable differences between the two flow regimes in the physical environments of near shore habitats occupied by rearing native fish, and there will be an added benefit under the Proposed Action in being able to compare these differences under both clear water and turbid water conditions.

High Experimental Flow

Effects of the No Action January flow and the Proposed Action November-December flow are anticipated to be similar. The food base along the river varies from a predominately autotrophic (powered by sunlight) system in Glen Canyon to a partially autotrophic or primarily allochthonous (powered by organic matter produced elsewhere) system below Glen Canyon. In both reaches, drift plays a role in food delivery to the fishery. The timing of a late fall or winter flood coincides with reduced productivity and abundance associated with invertebrates (McKinney et al. 1999, Rogers et al. 2003). The short duration disturbance would have a measurable, but temporary effect on the bottom-dwelling algae and invertebrate community. Silt and sand will be

reworked and aquatic macrophytes likely scoured. The resulting coarsened substrate should favor recolonization by algae rather than macrophytes (Yard and Blinn 2001) that support a different benthic association like the filamentous green alga *Cladophora*, diatoms, and the amphipod *Gammarus*. The terrestrial inputs associated with the increased discharge would provide a pulse of organic material that would be incorporated into sediment deposition and carbon cycling throughout the system. Increased drift should follow during the recovery periods. Removal of algal overgrowth may help facilitate new algal photosynthesis and an increase in gross productivity. Algal biomass recovery rates appear to be rapid following these large flow perturbations if algal basal holdfast structures are retained.

Terrestrial vegetation that is a host for invertebrates will be buried or scoured, but will recover and may respond by increasing vegetative productivity as a result of increased nutrient delivery. Increase vegetative productivity will increase host availability for terrestrial invertebrates that contribute to aquatic and terrestrial food base resources in the spring and summer months (Yard et al 2004; M. Yard unpublished data).

Non-native Fish Suppression Flows

Proposed Action increased fluctuations likely will produce increased drift relative to No Action fluctuations, but they also will likely increase turbidity in the mainstream below the Paria River confluence. Increased turbidity may affect feeding behavior and food availability of some fish species. It also may serve to interfere with sight-feeding predators on native fish. Shoreline vegetation that serves as host plants may be delayed in their development under this flow regime, but the increase in stage also could increase the area occupied by marsh or wetland plant species.

**Kanab Ambersnail**

Alternating Low Steady and Low Fluctuating Flows

These flows occur at stages below the lower limit of Kanab ambersnail (KAS) habitat and are expected to have no effect.

High Experimental Flow

There is expected to be no measurable difference in effect or in recovery between a high experimental flow in November-December or January. Habitat utilized by KAS normally has limited growth through the fall and early winter season and begins new growth in mid-February depending on climatic variables. KAS habitat as of August 2004 below 45,000 cfs was 119.40 $m^2$ (K. Kohl, personal communication). Values for habitat available in March 1996 prior to the BHBF were determined to be 120 $m^2$. Therefore, primary habitat that is estimated to be taken without mitigation should be

slightly less than the area lost in 1996 that was determined by USFWS to be within the 17% of incidental take limits.

Mitigation efforts in 2005 will include temporarily removing primary habitat that is below the high experimental flow stage and replacing these cuttings back to their original place following the high flow. The success of this action has yet to be determined; undoubtedly some plant mortality will occur, but the loss of habitat may be decreased through these efforts and may serve to reduce the total amount of incidental take associated with the high flow event. Because snails will also be temporarily removed, mortality that might be increased as a result of snails being washed away and drowned may be reduced through these conservation actions.

Losses of KAS habitat and KAS at Vasey's Paradise are partially offset by the developing population at Upper Elves Chasm. Long-term success of this population cannot be assured, but the population has persisted for 5 years. The 25 $m^2$ of estimated occupied habitat is approximately 20% of habitat expected to be temporarily lost at Vasey's Paradise under the Proposed Action, without the conservation action.

Non-native Fish Suppression Flows

Habitat at Vasey's Paradise for the ambersnail measured in August 2004 occupied an area down to the 17,000 cfs stage, because discharge from Glen Canyon Dam included releases in August up to 17,000 cfs. This habitat would be scoured prior to the suppression flows by the high experimental flow under both No Action and Proposed Action with sediment triggers being attained. The ambersnail habitat would not have recovered from the high experimental flow sufficiently for the non-native fish suppression flows to have an affect. If the high experimental flow is not released, the suppression flows would still be released under the Proposed Action. In this case there could be a small loss of ambersnail habitat from the high stage of the 5,000-20,000 cfs fluctuations.

Conclusion

We conclude that the Proposed Action may affect, and will likely adversely affect, KAS at Vasey's Paradise. The translocated Vasey's Paradise population at Elves Chasm will not be affected by the Proposed Action.

**Reptiles and Amphibians**

Alternating Low Steady and Low Fluctuating Flows

The deviation between the No Action and Proposed Action for these flows is expected to be small during water years 2005-2006 because in an 8.23 million acre-foot water year, all

flows during September and October will not exceed daily fluctuations of 5,000-10,000 cfs. Small fluctuations may provide more food resources in the varial zone between the high water and low water stage, but the difference is not expected to be significant to the ecology of these animals.

High Experimental Flow

Differences between the No Action and Proposed Action are expected not be measurable for reptiles and amphibians. In 2003, the Hopi Tribe raised concerns about the potentially negative effects of high flows on hibernating frogs, lizards, and snakes. Although data are apparently not available to provide direct evidence of this form of mortality in the Grand Canyon ecosystem, the potential exists to flood hibernacula of reptiles and amphibians during colder times of the year. Hypothetically, such mortality should be low since natural selection would strongly influence reptiles and amphibians to locate their hibernacula above sites that are routinely subject to flooding and inundation. Descriptive field observations in support of this hypothesis were presented in a final report from the Hopi Tribe (Huisinga and Yeatts (2003). They reported only four Grand Canyon rattlesnakes observed during the winter months of February-March, and all four were located in talus slopes or upland mesquite/boulder habitats. We anticipate that these conditions also would exist in the timeframe of high experimental flows under either the No Action or Proposed Action.

Non-native Fish Suppression Flows

These flows largely occur at a time of year when reptiles are inactive. April is a period of increased activity for reptiles, but their activity is still dependent on ambient temperatures and food availability. Following a high experimental flow, which can occur under either the No Action or Proposed Action, there will be increased open areas for reptile foraging. Differences in effects on amphibians between the two alternatives are expected not to be measurable.

**Trout**

Alternating Low Steady and Low Fluctuating Flows

These autumn flows are expected to cause minor decreases in the amount of drift available for trout food during the period of steady flows, but the duration of these flows is brief and the effects are expected to be short-lived.

High Experimental Flow

The high experimental flow of approximately 41,000 cfs is expected to affect trout through short-term changes in displacement of individuals and increased mortality,

particularly of fry and fingerlings, habitat modification concomitant with stage changes, and erosion of benthic algae and invertebrates resulting in increased drift during the period of increasing current velocities whether it occurs in November-December or January. Since the high flow can occur under either the No Action or Proposed Action alternative, differences in effect are restricted to those attributable to the timing of the event, and these differences are expected to be minor.

Non-native Fish Suppression Flows

Korman and others (2004) have demonstrated that fluctuating flows of 5,000-20,000 cfs increased incubation mortality of rainbow trout (RBT) in the Lees Ferry reach by 23%-33% above Record of Decision fluctuating flows in 2003-2004. They estimated that incubation mortality could have been increased to 40% had the non-native fish suppression flows been conducted through April, rather than ceasing them at the end of March, but that inclusion of the first week of April would result in only a minor increase in mortality.

There was minimal reproduction of RBT in Marble Canyon in 2004 based on a comparison of young-of-year densities in the reach with those in Glen Canyon. Therefore, the effects of non-native fish suppression flows likely were greatest in the reach of the Colorado River above the Paria River.

Mechanical Removal of Non-native Fish

Mechanical removal would occur only under the Proposed Action. Results from the ongoing removal effort for 9 trips (Jan – Mar 2003, July – Sept 2003, and Jan – Mar 2004) indicate that removal has a 50% efficiency for RBT and that consistent removal can have a persistent effect on this species' abundance in the removal area (Coggins and Yard 2004). The pattern of removal efficiency is not as consistent for brown trout (BNT). Predation on endangered HBC has been documented for both trout species, thus reduction in their numbers in the area of the Colorado River having highest numbers of the endangered cyprinid is anticipated to produce a positive effect.

**Humpback Chub**

Alternating Low Steady and Low Fluctuating Flows

Under the Proposed Action, these releases are intended to provide an opportunity to measure differences during differing hydrologies in sediment transport and in near shore rearing habitats of native fish. They would only occur under No Action if sediment input from the Paria River exceeded 500,000 metric tons by July 1. Therefore, there is a greater opportunity to learn the effects of these flows under the Proposed Action.

High Experimental Flow

Valdez and Ryel (1995) reported that adult and juvenile HBC found in the mainstream utilize deeper eddies in the fall and winter period (approximately late October through February), therefore they may be less affected by a short duration high flow of the proposed magnitude. Young-of-year HBC emerging from the Little Colorado River may suffer mortality as a result of the high flow event, but monsoonal floods that would transport them into the mainstream largely have ceased by the end of October. The mortality of young-of-year attributable to the high experimental flow is likely not discernable from other hypothesized, more consistent mortality factors associated with the mainstream, including cold temperatures (Valdez and Ryel 1995), predation, or loss of habitat.

Non-native Fish Suppression Flows

The non-native fish suppression flows would be extended by one week into April under the Proposed Action. These fluctuations could follow a November-December high flow that would hypothetically rework sediment in sandbars and pools of eddies (i.e., backwaters) the latter serving as habitat for young fish. These habitats are most often utilized by young fish emerging from tributaries in spring or summer. The time period proposed does conflict slightly with the life history traits of humpback chub and other native fish found in the Grand Canyon with respect to spawning. Fluctuations into the first week of April might have an effect on larvae that might be dispersed into the mainstream early as a result of tributary flows. Effects of fluctuations would be difficult to segregate from other effects that contribute to larval mortality (temperature, predation) under current mainstream conditions. The physical effects of the fluctuations on the habitats may include either loss or accumulation of sediment in the pools as sediment is transported downstream.

Mechanical Removal of Non-native Fish

Removal of non-native fish species in the Colorado River near the confluence of the Little Colorado River began in January 2002 as an experiment to determine if reducing predator load would benefit recruitment of HBC as well as other native fish that use the Little Colorado River. Because a response in recruitment by native fish, including endangered HBC, will not be likely to be recorded through monitoring until 2006 or 2007, the effect of mechanical removal on these target species presently is not known. The methods used have, however, determined that salmonid and carp numbers can be reduced with consistent and considerable effort (Coggins and Yard 2004).

Mechanical removal of non-native fish is accomplished by electrofishing and this method of capture may have short-term negative effects on HBC. Hoop net monitoring

of HBC accomplished to measure changes in the population of the endangered fish as a response to mechanical removal also may have short-term negative effects. As a means to alleviate adverse effects, the 2002 EA also included translocation of HBC above Chute Falls on the Little Colorado River, subsequently documented as a biological opinion conservation measure.

Conclusion

We conclude that the Proposed Action may affect, and is likely to adversely affect, HBC and its critical habitat. Adverse effects are expected to be short-term, and there is a high probability that both HBC and its critical habitat will accrue a long-term benefit from the Proposed Action.

**Razorback Sucker**

Razorback suckers are very rare in Grand Canyon and some fish biologists speculate that this species was never more than a transient member of the native fish fauna (Minckley 1991, Douglas and Marsh 1998). There is also a population of approximately 500 individuals that exist in Lake Mead. This population has been studied since 1996 (Holden et al. 2000), but no data exist to determine whether this population moves into Lower Grand Canyon. Under both the No Action and Proposed Action alternatives, razorback sucker is expected to remain very rare in Grand Canyon. Little to no successful reproduction or recruitment is expected to occur.

Conclusion

We conclude that the Proposed Action may affect, but is not likely to adversely affect, RBS or its critical habitat.

**Southwestern Willow Flycatcher (SWWF)**

Alternating Low Steady and Low Fluctuating Flows

No effects of these flows are anticipated on SWWF.

High Experimental Flow

SWWF is a neotropical bird that utilizes habitat along the Colorado River from May through August or September and winters in parts of Mexico to Panama. During the period of the high experimental flow under either the No Action or Proposed Action, there would be no SWWF present. The high experimental flow would inundate the ground area associated with known SWWF sites as well as other potential habitat, and would result in the reduction of ground cover and possibly low lying branches that

provide structure to habitat. Cover estimates for the river as a whole, but not for specific SWWF sites have decreased by approximately 10% for vegetation up to the 45,000 cfs stage level (Kearsley et al 2004). This loss is associated with the prolonged drought in the southwest. The scour of dead plants during the high flow may provide open patch areas for establishment by new understory plant species and improve habitat in the long term. The reworking of sediment may set the stage for improved SWWF habitat along the river's edge by changing productivity in marshes, promoting the presence of standing water associated with return channels, and exposing sandbars through aggradation.

Non-native Fish Suppression Flows

SWWF do not establish nests prior to May and as such the non-native fish suppression fluctuations would not interfere with their life history requirements. The flows would occur following sediment reworking and would affect the vegetated areas as well as beach areas. The physical effects of the fluctuations on the habitats may include either loss or accumulation of sediment along the shoreline up to the 20k stage level. The reworking may expose seed banks for plant colonization below the 45k stage. Plant colonization below the 20k stage will be delayed due to the unstable environment. Subsequent months may have the effect on terrestrial vegetation and associated SWWF habitat of increasing marsh habitat by increasing the wetted area available for marsh vegetation to occupy.

Conclusion

We conclude that the Proposed Action may affect, but is not likely to adversely affect, SWWF or its critical habitat.

**Bald Eagle**

Alternating Low Steady and Low Fluctuating Flows

Bald eagles are not in the project area during the period of these flows and thus will not be affected by them.

High Experimental Flow

A high flow taking place in November-January would likely have little affect on feeding behavior of bald eagles along the Colorado River. In the past, the presence of bald eagles along the river peaks in February and coincided with trout spawning in tributaries (Brown and Trosset 1989, Brown 1992). Bald eagles begin arriving in late November, so that timing of a high flow in under the No Action alternative may have a slightly larger affect on bald eagle foraging than would the same flow at an earlier time

under the Proposed Action. The earlier timing of the high flow under the Proposed Action also may reduce the effects of turbidity on foraging that might be encountered as discussed under the January high flow scenario.

Non-native Fish Suppression Flows

These flows are intended to reduce the populations of non-native fish, primarily salmonids, that prey upon or compete with native fish, particularly the endangered HBC. Korman and others (2004) have shown that they are successful in increasing incubation mortality of trout, therefore they may have a negative impact on the food base for bald eagles in Glen and Grand canyons. If native fish numbers are improved as a result of non-native suppression, however, and replace non-native fish in bald eagle diets, there is likely to be no measurable effect. Because most eagles have migrated northward by March, the extension of these flows by a week into April under the Proposed Action is unlikely to increase or decrease their affect on bald eagles. The reworked sediments may increase pool habitats that bald eagles forage in and may provide stranded fish for these birds as a food source.

Mechanical Removal of Non-native Fish

Mechanical removal of non-native fish in the mainstream above and below the mouth of the Little Colorado River is expected to negatively affect populations of non-native fish that serve as food for bald eagles, but this action also has a high potential for resulting in increased populations of native fish that also provide food for the eagles.

Conclusion

We conclude that the Proposed Action would have less effect on bald eagles than the No Action alternative. Therefore, we conclude that the Proposed Action may affect, but is not likely to adversely affect, the bald eagle in Grand Canyon.

**California Condor**

No measurable effects are anticipated from either the No Action or Proposed Action alternative on the experimental population of California condors. We conclude that the Proposed Action may affect, but is not likely to adversely affect, California condors.

**Recreational Activity: Angling**

Alternating Low Steady and Low Fluctuating Flows

There would be little difference between the No Action and Proposed Action alternatives in terms of angler access to the fishery. Periods of steady flows, which

would occur with or without sediment triggers under the Proposed Action, would result in lower densities of drifting organisms and thus could affect feeding activity among the trout sought by anglers.

High Experimental Flow

A high experimental flow in November-December could impact anglers and guides in the Lees Ferry reach more than the January flow because of the shorter notice and subsequent difficulty in rescheduling. Angling following the flows is expected to improve with rejuvenation of the benthic algae and invertebrate communities that form the food base for trout.

Non-native Fish Suppression Flows

Increased daily fluctuations during the period January-early April under the Proposed Action are expected to produce more drifting organisms than flows under the No Action. The periods of ramp up and ramp down in daily fluctuations are little affected by the Proposed Action and occur on cycles that have little impact on anglers' ability to access the fishery.

Mechanical Removal of Non-native Fish

In the Lees Ferry fishery, there should be no effect from this action. The reason for this is that the mechanical removal is being conducted well downstream of the fishery. No data are available on trout fishing downstream between the Lees Ferry fishery and the confluence of the Little Colorado River. Based on the results of the mechanical removal experiment, we expect that the number of trout has been and will continue to be reduced. This would be an adverse effect on anglers; however, this area is so little used that it is not considered significant or measurable.

**Recreational Activity: Boating, Camping and Day Use**

Alternating Low Steady and Low Fluctuating Flows

There is little discernable difference in recreational boating and camping experience anticipated between the low fluctuating flows under the No Action and the sequential low steady and low fluctuating flows under the Proposed Action. The daily stage change would vary from no change under steady flows to approximately one and one-half feet under low fluctuating flows. These stage differences are not expected to measurably affect access to camping sites, tending of boats and equipment, or the aesthetics of the river running experience.

High Experimental Flow

Timing of the high experimental flow in the period November-January is not anticipated to alter the effects on boaters and campers. Boaters and campers in the Colorado River below Glen Canyon Dam will be advised in advance of the high experimental flow. Glen Canyon National Recreation Area will determine what restrictions need to be placed on access to the Lees Ferry reach to ensure safety of recreationists. Grand Canyon National Park will do likewise for recreationists below Lees Ferry.

Non-native Fish Suppression Flows

Boaters and campers below Glen Canyon Dam have experienced these flows for the last two years and are accustomed to their effects. Accommodations must be made by these individuals for changes in river stage that occur at different times of day depending on how far their parties happen to be below the dam. Tending of boats to prevent their stranding and ensuring that campsites are below the high water stage are the major inconveniences of these flows.

**Cultural Resources**

Alternating Low Steady and Low Fluctuating Flows

The alternating low steady and fluctuating flows should have no effect on the three historic inscriptions and the Spencer Steamboat in the area that might be affected by flows. The Arizona State Historic Preservation Officer has concurred that adverse effects of dam operations on these historic properties have been previously mitigated through documentation and no further work is necessary on these properties.

Native American tribes that consider the canyons and river sacred have been and continue to be consulted about whether these flows might restrict their access to or ceremonial use of the canyons and river. To date they have expressed no concerns with these flows or effects of these flows.

High Experimental Flow

A high experimental flow could alter five prehistoric sites; however, prior to conducting the 1996 experimental 45,000 cfs flow, adverse effects of dam operations on these properties were mitigated. A flow of the magnitude and duration proposed here would have no further effect on these previously treated sites.

During government-to-government consultation on the 2002 EA, the Hopi Tribe, Pueblo of Zuni, Navajo Nation, Hualapai Tribe, and Kaibab, San Juan, and Shivwits Bands of Paiute Indians (represented by the Southern Paiute Consortium) identified no effects of high flows on traditional cultural properties or sacred sites. Some of the tribes expressed

concern with effects on particular species of plants and wildlife that are valued for traditional or cultural reasons. These concerns are addressed under the individual resources and through ongoing consultation with the tribes.

Mechanical Removal of Non-native Fish

In the original experimental proposal, four tribes stated that mechanical removal of non-native fish would compromise the physical integrity and adversely affect sacred sites and resources of tribal concern. Thus, the mechanical removal component, with the resulting death of fish and lack of beneficial use of such fish, was originally considered an adverse impact. This effect was mitigated by having the Hualapai Tribe use the harvested fish in their gardens. While the addition of the fish to the gardens was successful, the Tribe may have limited need for the fish that might be harvested through this continuation of the proposal. Consultations will be undertaken to determine how the fish might be put to beneficial use; however, such mitigating measures have not been defined at this time.

**Hydropower**

Impacts to hydropower revenues and the Basin Fund result primarily from several changes from No Action, (1) shifting the high flow test from January to November thus shifting 90,000 acre feet of bypass flows from January to November, (2) increasing the December release volume and daily fluctuations, (3) increasing January - March fluctuations during the non-native fish suppression releases, and (4) modifying the release volume and pattern in September and October.

The financial impact of the bypassed water is about $1 million; however this is expected to be more than compensated financially by increased winter fluctuations and an increased release volume in December. Since some months have reduced purchase power requirements and some months have increased purchase power requirements compared to No Action, the financial impact is partly a function of the price forecast used. Using current forecasted market prices, Western Area Power Administration estimates that the overall financial impact of the Proposed Action would be beneficial.

**Cumulative Impacts**

Cumulative impacts are the impacts on the environment resulting from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency or person undertakes such other actions. In the 2002 EA, the agencies identified eight other federal projects that were considered for their potential cumulative impacts on the action area below Glen Canyon Dam. The key analysis here is the difference between No Action and the Proposed Action. The critical variables for cumulative impact analysis are the timing of the experimental high flow; the addition, with or without sediment inputs of the alternating low steady and fluctuating flows**;** and the continuation of mechanical removal and non-native fish suppression flows.

The proposed continuation and slight modification of the 2002 experimental proposal should not result in any adverse cumulative impacts because (1) the mechanical removal of non-native fish is successful at reducing their populations and has the potential to result in benefits to endangered species; (2) non-native fish suppression flows have been demonstrated to increase the mortality of non-native fish that are known predators of endangered fish and they may improve the tailwater trout fishery by reducing the number of fish and improving growth; (3) the high flows are expected to improve sediment conservation and result in larger, longer-lasting near shore rearing habitats and beach deposits that will benefit native fish and recreationists; and (4) the alternating low steady and low fluctuating flows are within the bounds of similar flows that have occurred since the Record of Decision was issued in 1996, but they are intended specifically to determine what effects they have on a combination of sediment conservation and endangered fish protection.

## DECISIONS NEEDED AND PERMITS REQUIRED

The decision to be made by the joint lead agencies as the result of this supplemental EA will be one of the following:

- Finding of No Significant Impact
- Prepare an Environmental Impact Statement
- Withdraw the Proposed Action

A variety of permits would need to be issued should the Proposed Action be implemented. The National Park Service is responsible for decisions relating to the issuance of special use permits for research and monitoring activities proposed within the boundaries of Glen Canyon National Recreation Area and Grand Canyon National Park. Any proposed activities related to this environmental assessment that would

necessitate entry onto the Hualapai Indian Reservation or the Navajo Nation would require permits from the tribes and possibly from the U.S. Bureau of Indian Affairs.

All persons working with threatened or endangered species would have to obtain permits from the U.S. Fish and Wildlife Service. The U.S. fish and Wildlife Service will issue a biological opinion on the Proposed Action.

Researchers working with resident fish or wildlife species would need an Arizona Game and Fish Department permit. No other permits would be required.

**Consultation and Coordination**

Consultations with the Hopi Tribe, Navajo Nation, Kaibab Band of Paiute Indians, Paiute Indian Tribe of Utah, Pueblo of Zuni, and Hualapai Tribe occurred during the meetings of the GCDAMP. Government-to-government consultation meetings over the original experimental proposal were held with the Hopi Tribe, Hualapai Tribe, and Kaibab and Shivwits Bands of Paiute Indians during August and September 2002. Additional consultation on the effects of the Proposed Action are ongoing with the tribal and state historic preservation officers, tribes, and other interested parties.

This document was prepared after consultation and coordination with the public and stakeholders of the GCDAMP. Public comment was received through the course of AMWG and TWG meetings and conference calls. This document also is being circulated for public review and comment for 14 days. The deadline for comment is noon on Friday, November 19, 2004. All substantive public comments will be considered in the determination of effects on the human environment and issues associated with the proposed modification to experimental flows.

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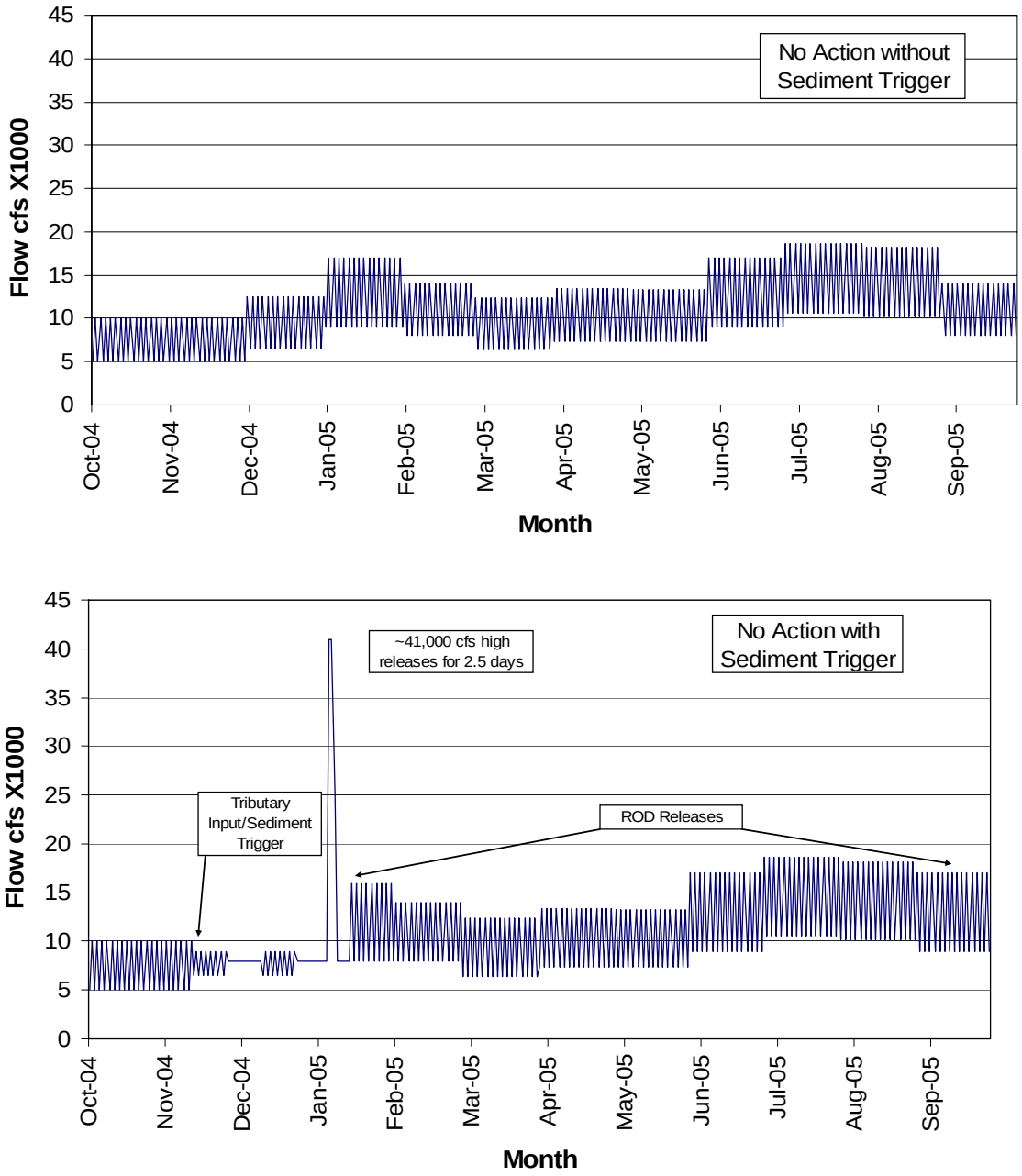


Figure 1. No Action scenario without and with a sediment trigger sufficient to trigger a high experimental flow from Glen Canyon Dam.

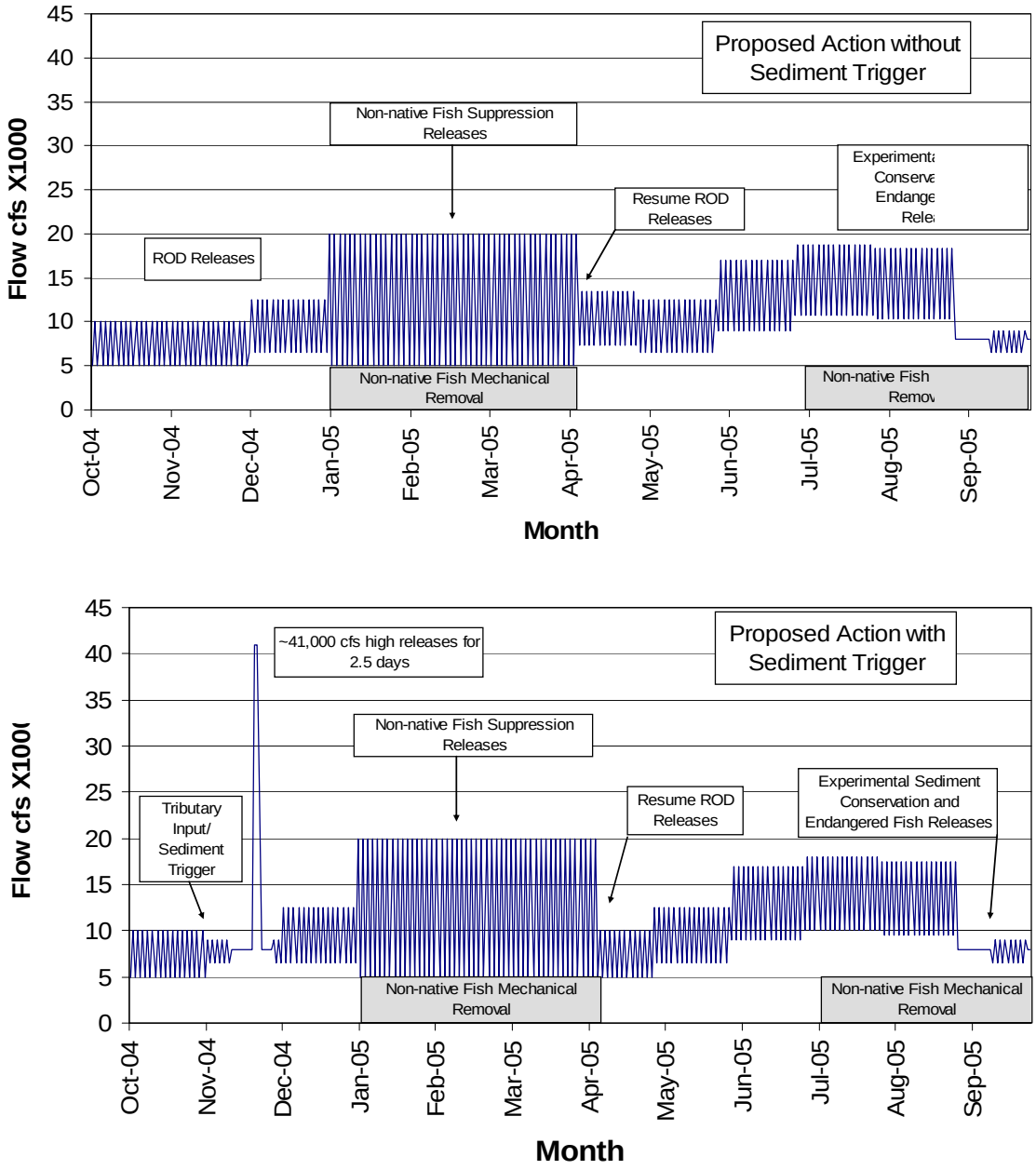


Figure 2. Proposed Action scenario without and with a sediment trigger sufficient to trigger a high experimental flow from Glen Canyon Dam.

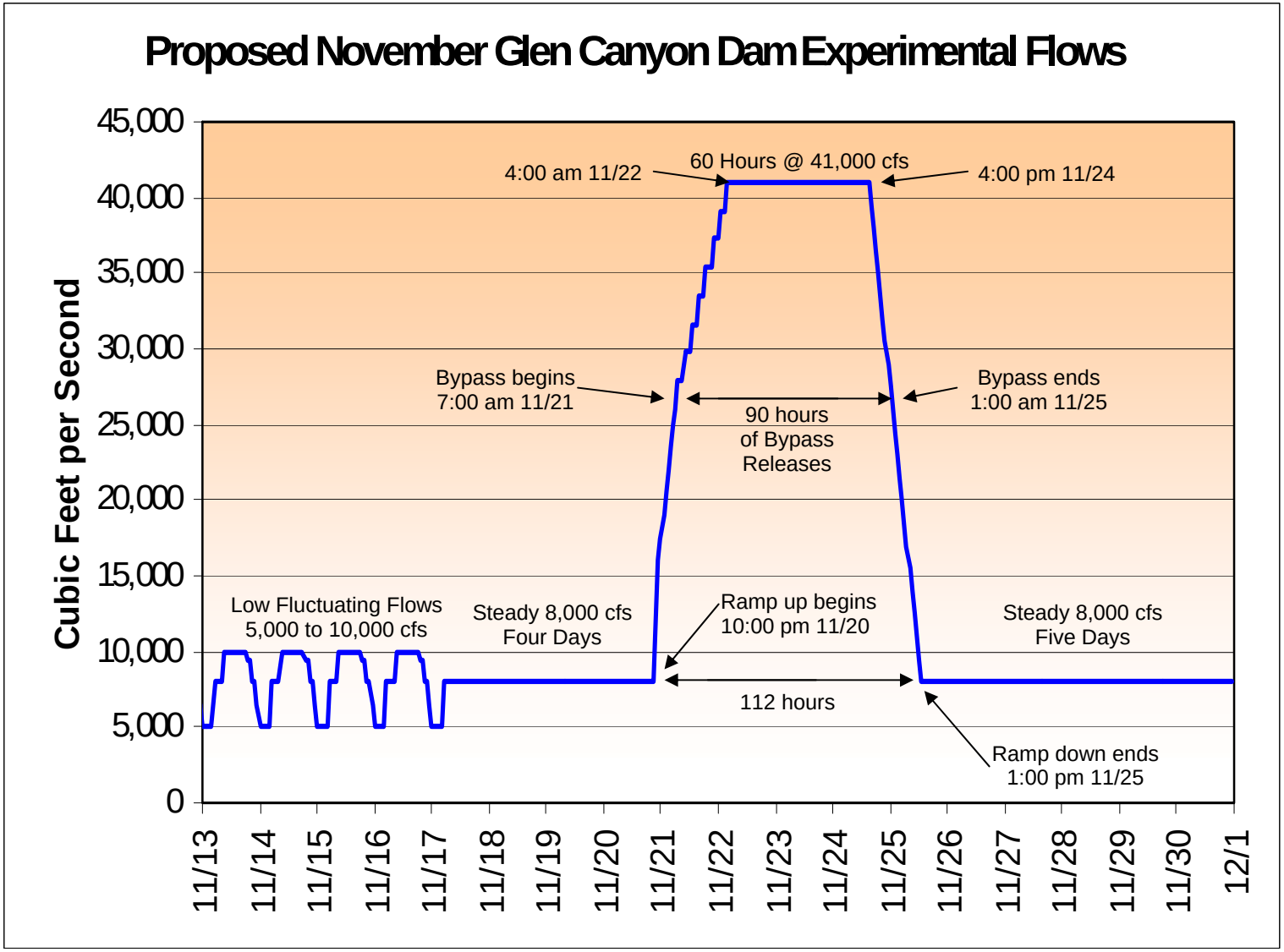


Figure 3. Detailed portrayal of the proposed high experimental flow.

Table 1. No Action and Proposed Action Glen Canyon Dam releases for water years 2005 and 2006.

| | No Action with Sediment Trigger | | | No Action without Sediment Trigger | | | Action with Sediment Trigger | | | Action without Sediment Trigger | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Monthly Vol X1000 | Daily Min | Daily Max | Monthly Vol X1000 | Daily Min | Daily Max | Monthly Vol X1000 | Daily Min | Daily Max | Monthly Vol X1000 | Daily Min | Daily Max |
| Oct-04 | 492 | 5 | 10 | 492 | 5 | 10 | 492 | 5 | 10 | 492 | 5 | 10 |
| Nov-04 | 476 | 5 | 10 | 476 | 5 | 10 | 700 | 5 | 10 (41) | 476 | 5 | 10 |
| Dec-04 | 492 | 5 | 10 | 600 | 6.5 | 12.5 | 600 | 6.5 | 12.5 | 600 | 6.5 | 12.5 |
| Jan-05 | 850 | 8 | 16 (41) | 850 | 9 | 17 | 792 | 5 | 20 | 792 | 5 | 20 |
| Feb-05 | 650 | 8 | 14 | 650 | 8 | 14 | 723 | 5 | 20 | 723 | 5 | 20 |
| Mar-05 | 600 | 6.4 | 12.4 | 600 | 6.4 | 12.4 | 807 | 5 | 20 | 807 | 5 | 20 |
| Apr-05 | 600 | 7.4 | 13.4 | 600 | 7.4 | 13.4 | 500 | 5 | 10 | 600 | 7.4 | 13.4 |
| May-05 | 650 | 7.3 | 13.3 | 650 | 7.3 | 13.3 | 600 | 6.5 | 12.5 | 600 | 6.5 | 12.5 |
| Jun-05 | 800 | 9 | 17 | 800 | 9 | 17 | 800 | 9 | 17 | 800 | 9 | 17 |
| Jul-05 | 910 | 10.6 | 18.6 | 910 | 10.6 | 18.6 | 858 | 10 | 18 | 920 | 10.8 | 18.8 |
| Aug-05 | 910 | 10.2 | 18.2 | 910 | 10.2 | 18.2 | 858 | 9.5 | 17.5 | 920 | 10.4 | 18.4 |
| Sep-05 | 800 | 9 | 17 | 692 | 8 | 14 | 500 | 8/6.5 | 8/9 | 500 | 8/6.5 | 8/9 |
| WY Volume | 8230 | | | 8230 | | | 8230 | | | 8230 | | |
| Oct-05 | 492 | 5 | 10 | 492 | 5 | 10 | 492 | 8/6.5 | 8/9 | 492 | 8/6.5 | 8/9 |
| Nov-05 | 476 | 5 | 10 | 476 | 5 | 10 | 700 | 5 | 10 (41) | 476 | 5 | 10 |
| Dec-05 | 492 | 5 | 10 | 600 | 6.5 | 12.5 | 600 | 6.5 | 12.5 | 600 | 6.5 | 12.5 |
| Jan-06 | 850 | 8 | 16 (41) | 850 | 9 | 17 | 792 | 5 | 20 | 792 | 5 | 20 |
| Feb-06 | 650 | 8 | 14 | 650 | 8 | 14 | 723 | 5 | 20 | 723 | 5 | 20 |
| Mar-06 | 600 | 6.4 | 12.4 | 600 | 6.4 | 12.4 | 807 | 5 | 20 | 807 | 5 | 20 |
| Apr-06 | 600 | 7.4 | 13.4 | 600 | 7.4 | 13.4 | 500 | 5 | 10 | 600 | 7.4 | 13.4 |
| May-06 | 650 | 7.3 | 13.3 | 650 | 7.3 | 13.3 | 600 | 6.5 | 12.5 | 600 | 6.5 | 12.5 |
| Jun-06 | 800 | 9 | 17 | 800 | 9 | 17 | 800 | 9 | 17 | 800 | 9 | 17 |
| Jul-06 | 910 | 10.6 | 18.6 | 910 | 10.6 | 18.6 | 858 | 10 | 18 | 920 | 10.8 | 18.8 |
| Aug-06 | 910 | 10.2 | 18.2 | 910 | 10.2 | 18.2 | 858 | 9.5 | 17.5 | 920 | 10.4 | 18.4 |
| Sep-06 | 800 | 9 | 17 | 692 | 8 | 14 | 500 | 8/6.5 | 8/9 | 500 | 8/6.5 | 8/9 |
| WY Volume | 8230 | | | 8230 | | | 8230 | | | 8230 | | |
| | Assumptions:<br>(1) no non-native fish suppression flows Jan-Mar; (2) high experimental flow in Jan; release peak flow in ( ). | | | Assumptions:<br>(1) no non-native fish suppression flows Jan-Mar; (2) no high experimental flow in Jan. | | | Assumptions:<br>(1) non-native fish suppression flows Jan-early Apr with sediment trigger; (2) 2.5 day Nov-Dec high flow event; release peak flow in (); could occur in either month. | | | Assumptions:<br>(1) non-native fish suppression flows Jan-early Apr without sediment trigger; (2) no Nov-Dec high flow event | | |

Table 2. Differences between the No Action and Proposed Action alternatives.

| | No Action | Proposed Action |
|---|---|---|
| Anticipated Annual Dam Release | 8.23 maf | 8.23 maf |
| High Experimental Flow | | |
| -500,000 metric ton fine sediment input Jul 1-Sep 1 | Alternating low steady and low fluctuating flows | Alternating low steady and low fluctuating flows |
| -1,000,000 metric ton fine sediment input by Oct 31 | Continue alternating fluctuating and steady flows | Not applicable |
| -800,000 metric tons fine sediment in Upper Marble Canyon Nov 15-Dec 31 | Not applicable | Release high experimental flow of ~41,000 cfs preceded and followed by 8,000 cfs steady flows |
| -800,000 metric tons fine sediment in Upper Marble Canyon by Dec 31 | Release high experimental flow of ~41,000 cfs in early Jan preceded and followed by 8,000 cfs steady flows | Not applicable |
| Non-native fish suppression flows 5,000-20,000 cfs | Not applicable | Release from Jan 1 through first week of Apr |
| Mechanical removal above and below Little Colorado River | Not applicable | Conduct Jan-Mar and Jul-Sep |